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NINETY-EIGHTH YEAR

AMERICAN Gas Journal

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JULY 1956

Only Magazine Published Exclusively for the Gas Utility Industry

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Good Everywhere

memo: from the publisher

HORACE Greeley's famous expression, "Go West, young man, go West," is as meaningful today as it was in 1854. We have just spent two weeks and traveled 3000 auto miles to see firsthand the scenic beauty and natural wonders of our Rocky Mountain western states. To one who has not been privileged to spend much time in this area in recent years, the growth and development is truly astounding. In a land once devoted almost entirely to farming and ranching, the economy is now strengthened and enriched by many virile and growing industries. Oil, gas, and uranium are playing an increasingly important role in the area's industrial and cultural development.

The Pacific Northwest pipe line now under construction, in bringing vital gas to new areas of our nation, should trigger a small boom along much of its right-of-way. To an already strong gas industry in the Rocky Mountain West, this activity will undoubtedly be a stabilizing factor and enhance the overall industrial potential of the entire area.

We are indebted to such genial gas industry people as Colorado Public Service Company's John E. Loiseau and Tom Parks; Northern Utilities Company's A. V. Lavin; Cheyenne Light, Fuel & Power Company's O. P. Reed, L. J. Webber, and many others, for enabling us to get a very long look in a very short time. It's gratifying and stimulating to visit with people like these; people who know where they're going and what to do when they get there.

OUR American Gas Journal editors are getting around, too. AGJ Editor Dean Hale has just returned from extensive travels through Pennsylvania, Ohio, Michigan, Illinois, and Missouri. Don Taylor, our prolific writing Gulf Coast Editor, is currently traveling the Pacific Northwest Pipe Line, getting the story of what this newest, gas carrier will mean to Portland, Seattle, and all the towns along the line from San Juan Basin to the Pacific Northwest area. Engineering Editor Jim LeVelle has been busy on an extensive trip to the East Coast and Canada. We think you will be intensely interested in the feature material and general reporting from these travels that will appear in subsequent issues of AGJ.

Joe B. Hooks

NINETY•EIGHTH YEAR

AMERICAN Gas Journal

JULY, 1956

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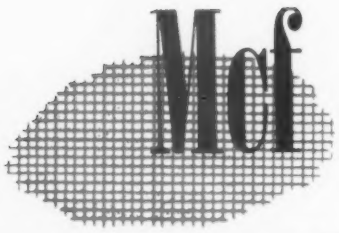

Construction contracts have been let on four of seven sections of the 574-mile, 34-in. Alberta to Winnipeg part of Trans-Canada Pipe Line, with completion of this first part slated for December 31, 1956. Announcement of the awards came shortly after approval by Parliament of a plan for government financing of the section of the line across Northern Ontario, which has stymied plans of the gas pipe line company since the project was conceived over five years ago. Certification of the big 2250-mile project was predicated on an "all-Canadian" line, which sponsors said would be infeasible without government backing of the section that would traverse a sparsely-settled northern Ontario area.

Customers in western Wyoming and Utah of Mountain Fuel Supply Company will begin receiving natural gas from the San Juan Basin as result of an agreement between the company and Pacific Northwest Pipeline Corporation. Mountain Fuel will buy some 50,000,000 cu ft daily from PNWPL at a point in Sweetwater County, southern Wyoming, where pipe lines of the two firms cross. Mountain Fuel also plans to build 38 miles of 20-in. loop lines to transport the increased gas supply.

Increases in domestic and commercial customer loads this year may force Arkansas-Louisiana Gas Company to invoke the interruptible clause in contracts with industrial customers. In a letter to individual customers the company advised firms without stand-by heating facilities to consider if they might want such equipment, and for those with such facilities, they were advised to put them in working order. Possibly of gas service curtailment on peak winter days is a question of growing pains, the company pointed out.

Natural gas service to customers in 23 southern Idaho communities may begin in mid-September, according to plans announced by Intermountain Gas Company. Gas for delivery will be ready at that time from Pacific Northwest Pipeline Corporation. Idaho Natural Gas Cooperative Association, representing local cooperative distributing agencies in 12 Idaho communities, has also received contracts from Pacific Northwest similar to the pipe line's contract with Intermountain. Construction of distribution systems throughout the state is now getting underway.

Caloric Appliance Corporation has withdrawn its claim, "Guaranteed the World's Fastest Cooking Range," based on the four 12,000 Btu burners supplied as standard equipment on its Ultramatic line. Reason cited is that other manufacturers are increasing burner input on one or more ranges in their respective lines. LeRoy Klein, Caloric's sales vice president, noted in a letter to the industry, that the race for more heat at the burner may work to the detriment of manufacturers of both gas and electric ranges. He said that his company feels there is a limit to top-burner input in keeping with maximum efficiency, deterioration and burn-out of cooking utensils and grate and burner bowl life.

AMERICAN GAS JOURNAL this month embarks on its 98th consecutive year of publication. Faithfully chronicling the "happenings" of the gas industry through the years, AGJ has reported its growth from an infant to the sprawling giant that today is the nation's sixth largest industry. In 1859, when today's AGJ's predecessor began publication, natural gas was hardly known, and the manufacture, distribution, and utilization of gas was a new field. There have been a lot of changes in the 97-year interim . . . the following item from the May 18 issue of The New York Times highlights this progress . . .

"Natural gas, until recently the country cousin of the oil business, has gone to town with such a bang that it is now the nation's sixth largest industry. Used 3000 years ago by the Chinese, natural gas was first produced commercially in the United States in 1821 near Fredonia, New York, says the National Geographic Society.

"Natural gas was not obtained in quantity, however, until oil began to flow — after 1859. And then, without pipes to deliver it, it had to be burned off as a bothersome by-product. In Fredonia gas had been distributed through hollowed-out logs. Pipes of iron, lead, and concrete also had been tried. But for the big push, the industry waited for modern steel pipe. These began coming in the late 1920's, only to be held up by the shortage of steel during World War II.

"Since the war, steel pipe lines have veined the country, reaching into every state but five and totaling, end to end, 420,000 miles, or 17 times the distance around the globe.

"Thus, through one of the world's great transportation systems, the invisible vapor flows, unheard and unseen. Except for pumping stations and office buildings, the natural gas industry runs underground. Even storage facilities, mostly old abandoned gas fields, are hidden in the earth. * * *

"Today, Italy leads Western Europe in natural gas production. Thanks to her gas boom, she is fast trimming coal imports. So is Pakistan, the first nation in Asia to use natural gas as a major source of fuel. Last September, in West Pakistan, gas began flowing through a new 350-mile pipe line that connects factories in Karachi with wells in Sui. Only months before, natural gas was also discovered in East Pakistan.

"Despite such developments, more than 80 per cent of the world's natural gas is still produced in the United States. Texas alone supplies half the total used in 22,000,000 American homes and 2,000,000 industrial plants. But 28 other states also contribute. New pipe lines now being built will soon connect Washington, Oregon, and Utah with wells in the San Juan River Basin in Colorado and New Mexico, and the Peace River district in Canada. When the Northwest service is completed, only Maine and Vermont will be without lines."

Conversion of Consolidated Edison Company of New York's gas distribution system to natural gas is nearly completed. July 31 has been set as the day when the last customer's equipment will be changed over. The entire conversion project, handled mostly by Con Ed's own crews, has proceeded smoothly.

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While lack of use causes some stops to corrode, false ports in the Lub-O-Seal guard against corrosion while the stop is closed. An independently-lubricated key distributes lubricant over seating surfaces each time stop is operated, assuring easy turning at all times. "O" rings store lubricant under pressure and original ease of turning is attained by refilling lubricant reservoir at bottom of key.

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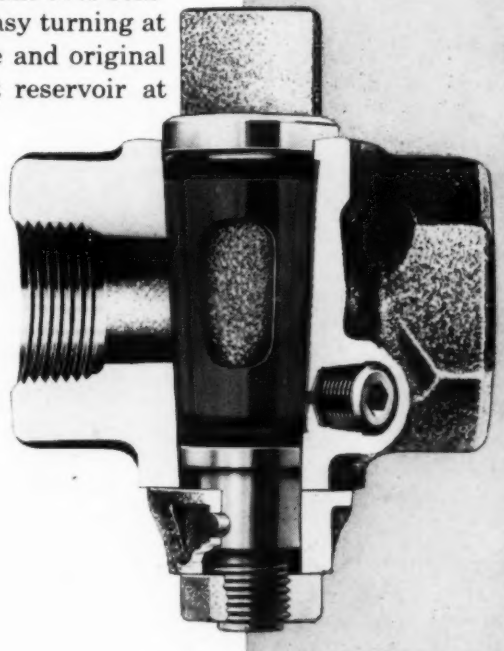

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H-11175 lock wing
Sizes ¾" through 2½"

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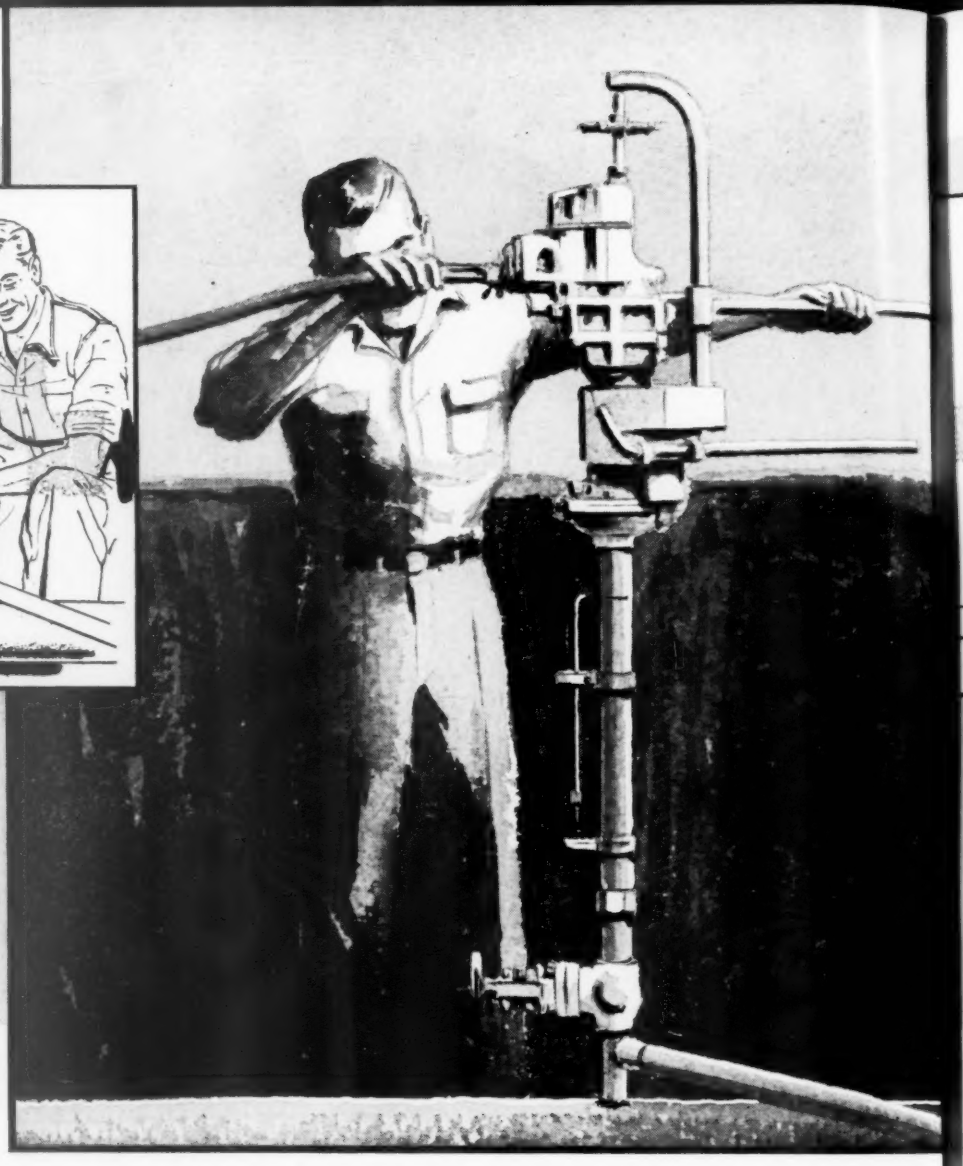
STEP 1: Weld fitting to main and service line. Test. Attach Mueller H-10916 high pressure steel gate valve to fitting.

STEP 2: Attach drilling machine to gate valve. Drill line. Retract boring bar and close valve. Open bleeder valve to relieve pressure and remove drilling machine.



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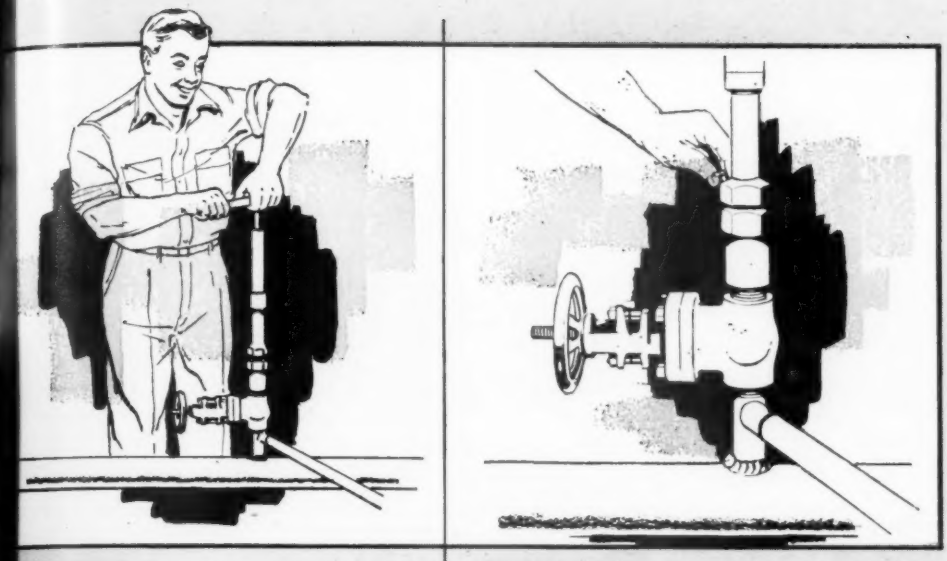
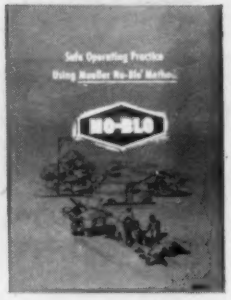


STEP 3: Attach completion plug, valve stem and bushing, or valve stem, depending on fitting used, to the completion machine. Mount on gate valve, open valve and insert.

STEP 4: Open bleeder valve on bottom of completion machine to check tightness of plug or valve and to relieve pressure. Remove completion machine and gate valve. Install completion cap.

Write for the new No-Blo® Method Booklet, "Safe Operating Practice." It shows how other gas installations are made in a safe manner, without escape of gas.



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The Law:

Legal Authority of Salesmen

Leo T. Parker
Attorney at Law

The lawful and usual legal right of an ordinary salesman to bind his employer, whether the gas corporation is seller or buyer, on a contract of sale is well established by higher court decisions. All courts hold that an ordinary salesman has no authority to make a valid contract of sale without the special authority, approval or acceptance of his employer.

In other words, the extent of an ordinary salesman's authority is to merely solicit orders and send them to his employer. And until the employer actually accepts the order sent by the salesman no valid contract exists, unless the testimony shows that the employer gave the salesman special and unusual authority to make valid contracts.

For this reason, notwithstanding printed or written clauses in an order form, to the contrary, a purchaser may cancel the "order" any time before the salesman's employer accepts it.

The courts hold, that when a notice of countermand is given by a purchaser to the same salesman who took the order, if such cancellation is given before acceptance of the order by the employer, it is the salesman's legal duty to cancel the order and communicate such notice to his employer, and his failure to do so will not result in a valid contract. *(See 24 P. (2d) 384).*

On the other hand, any special agreement between a purchaser of gas appliances or products and the salesman's employer is valid when the salesman has been given "special" authority to make valid contracts binding on the employer. Under these latter circumstances the purchaser is obligated to fulfill the terms of the contract made with the salesman, at the instant the contract is signed.

An important question: Is a valid contract completed where the salesman does not transmit all details of the complete agreement to his employer for acceptance, and as a result of this failure or neglect on the part of the salesman the employer accepts only part of the agreement?

For illustration, in the leading case of *Floor v. Mitchell, 41 Pac. (2d) 281,* the testimony shows facts as follows: A manufacturer's salesman entered into a sales contract in writing with a purchaser of gas appliances. This sale contract was a printed form that contained a clause to the effect that the contract shall not be regarded as binding on the manufacturer until accepted by the manufacturer. The contract also stated that the salesman was not authorized to accept or make binding contracts for the manufacturer and further "it is understood" that the seller shall not be bound by any agreements or representations "not contained in this agreement".

Without knowledge or authority of the manufacturer, the salesman and the purchaser signed a secondary written agreement to the effect that the merchandise was guaranteed to "give satisfaction". Both contracts were made in duplicate. The originals were retained by the manufacturer's salesman presumably to be sent to the manufacturer. The salesman, however, did not send the secondary contract "guaranteeing satisfaction" to his employer but sent only the regular printed contract, which, later the manufacturer accepted by writing to the purchaser.

The purchaser was not satisfied with the quality of the merchandise and refused to make the agreed payments directing attention of the manufacturer to the secondary written contract in which the salesman had "guaranteed" that the purchaser would be satisfied.

The manufacturer filed suit against the purchaser and contended that the secondary agreement was invalid and without force or effect, and not a part of the contract, because the salesman had not sent it to the manufacturer and it was not approved or accepted by the manufacturer.

It is interesting to know that the higher court listened to all details of the testimony and held that no valid contract existed, and that the purchaser was not obligated to pay for the merchandise. The court said:

"The defendant (purchaser) made an offer through an agent, which consisted of two contemporaneously drawn instruments. The plaintiff's (manufacturer) agent failed to transmit one of the instruments. The principal (manufacturer) therefore, unknowingly accepted what it thought was the offer consisting only of the signed printed form. Since the offer of the defendant (purchaser) consisted of the two instruments failure to accept the whole of the offer was no acceptance at all."

In other words, this court held that if a salesman fails to send to his employer all written agreements signed by the purchaser, the salesman's employer cannot accept or approve either part or the whole contract. Hence, no valid contract is made and neither the buyer nor the seller is obligated by the terms of the complete, or any part, of the alleged contract.

Another important point of the established law is that an employer always is responsible for "fraud" of his agent when making a sale. Therefore, in the above case the court's decision would not have been the same if the court had decided that the salesman practiced fraud on the purchaser, when making a secondary contract without knowledge of his employer.

If the salesman had been guilty of fraud, his employer would have been compelled by the court to fulfill the exact terms of both the first and secondary contract. However, no fraud was involved and hence the court held the contracts void.

In *Myers v. Malone and Hyde, Inc. 173 Fed. (2d) 291,* the testimony showed that a seller sold certain merchandise as "Extra Standard" in quality. Later it developed that the merchandise was poor in quality and the purchaser disposed of it for the best price obtainable, and then sued the seller for the difference between the price paid for the merchandise and the price received on the open market. The higher court held the seller entitled to recover $7,333 damages, and said:

"The proof established Myers (seller) had sold the merchandise to plaintiff as Extra Standard in quality and it was not that quality but was of inferior quality . . ."

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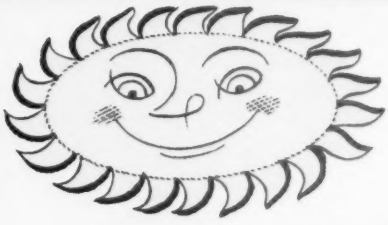

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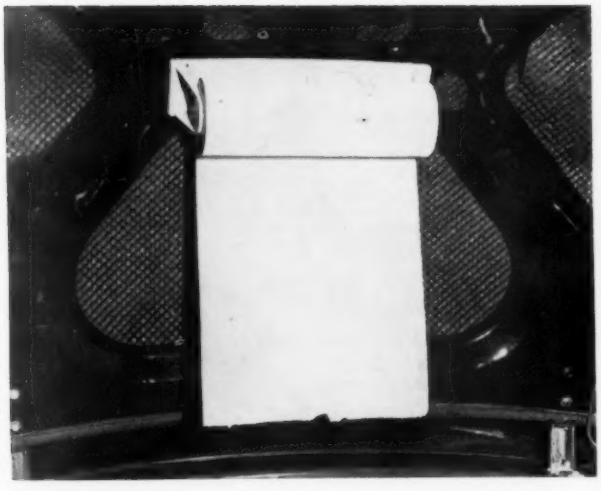
Skylight in compressor building saves electricity. Install sheets of translucent plastic in the roof of the compressor building and other buildings as well and save on the use of electric power during the daytime.

Electric power is used needlessly because lighting in compressor buildings is often such that electric lights are needed even on bright days. But in this case, every third panel of corrugated transite on the middle section of each side of the roof was replaced by corrugated plastic, and the overhead lighting is good even on cloudy days. The plastic is installed just like regular sheets of the roofing material.



Mount Paper Towel Rack In Trunk of Service Car. Field service personnel are always troubled with the problem of greasy hands at the end of a job. When really needed, rags are difficult to locate. To overcome this problem, a regular kitchen paper towel rack was mounted on the underside of the trunk door on the service man's car. The rack can be fixed securely by attaching with screws or bolts. Standard size absorbant paper is always available at most grocery stores, and makes it easy to keep the rack supplied.

At the end of a greasy job at the rig, the well or tank battery, the service man always can find something to wipe his hands on . . . in the trunk of his car. There is enough paper to last a long time, and it can be discarded when used.

Handy handle for pipe saves fingers. Should a survey be made of injuries around a pipe yard it would more than likely reveal smashed fingers to be the number one injury. This gadget keeps rolling pipe from flattening the loader's fingers. With it the loader can twist pipe, start it to rolling down the ramp, etc., without ever laying hands on the pipe itself. The gadget is made with a 2-ft section of inch steel bar, bent at the end. Another short section has been welded to it to make the double hook.

Gas Service Design

Final report of AGA Task Group outlines current practices of 48 companies across the nation

B. E. Hunt, *Illinois Power Company, Decatur, Illinois*

J. H. Erwin, *Central Illinois Electric & Gas Company, Rockford, Illinois*

H. T. Libby, *British Columbia Electric Company, Ltd., Vancouver, B. C.*

This report is a review of present practices in the design and construction of gas services. No attempt has been made to draw conclusions as to the best design for a particular situation, but the information and illustrations should help, by indicating the degree of acceptance of various practices within the industry. The report confines itself to the design of residential and small commercial services, eliminating discussion of industrial gas services or industrial meter installations.

The numerous tables and illustrations included were developed from replies to a questionnaire sent to representative gas companies. We have attempted to tabulate the data gleaned from these questionnaires and to include those illustrations which will be of most interest.

As originally assigned in 1953, the AGA Gas Service Design task group investigated all aspects of gas service design from the connection with the main through the outlet of the customer's meter. Special attention was given to sizing the service, service entrances to basementless houses, outside shutoffs and conformance to various state and special codes.

The problem of service entrances to basementless houses was given immediate attention and a report was presented at a luncheon conference in 1954 entitled "Examples of Good Practice in the Design of Gas Services to Basementless Houses."

Following the presentation of this report a second questionnaire was prepared and sent to representative gas companies. Of approximately 75 questionnaires mailed, replies were received from 48 companies. These replies represent approximately 48 per cent of the gas meters in service at the end of 1954 and 32 out of the 48 states. Thirty-eight of the companies distribute natural gas, six manufactured gas and four mixed gas. Twenty-one of the companies' operations are confined to a local urban area while 27 have widely scattered operations. Approximately 70 per cent of the companies have some type of corrosion mitigation program in effect.

Pressure Ranges

Although gas is distributed at many different pressure ranges, most of the companies consider as low pressure any pressure less than ½ psig. For the purposes of this report, intermediate pressure is taken as from 1 to 15 psig and high pressure from 15 to 60 psig. A maximum pressure of less than 50 psig is preferred by most companies while the maximum pressure allowed within the house is limited to 25 psig by more than 50 per cent of the companies.

Pipe Sizing

The most important problem initially in the design of a gas service is the selection of the pipe size. Many different bases are available and used in selecting the proper size. Some use a maximum size for all services; others make a detailed pressure drop calculation for each installation. A brief description of the methods followed by a majority of the companies will be of interest.

Consideration of connected load, length of service, and main pressure are made in selecting service pipe size. Generally this combination of variables is handled by means of selecting an allowable pressure drop for a particular main pressure and then selecting the pipe size based upon length of service and anticipated load, which will result in a calculated pressure drop of less than the allowable.

As it is usually the easiest to determine the connected load on a gas service this flow is used to size the service pipe. Some companies refine the principle by introducing a diversity factor based upon the assumption that all of the appliances will not be in use at the same time. Others assume that the service will ultimately supply a piece of gas space heating equipment and size the service for this load even if no househeating load is installed at present.

The pressure drop allowed on a gas service is primarily a function of the pressure being carried on the mains during the time the mains are supplying the peak demand.

In a low pressure system which operates at a nominal main pressure of from 6 to 8 in. of water column, most of the companies consider the maximum allowable pressure drop on a gas service to be either 0.3 in. or 0.5 in. of water column.

An intermediate pressure system operating at a mains pressure of from 1 to 15 psig will generally permit an allowable pressure drop of about ½ psig.

High pressure distribution systems permit allowable pressure drops of from ½ to 3 psig. Another method of

ESTIMATED DEMAND OF GAS APPLIANCES 1000 BTU/CF	CFH
DOMESTIC GAS RANGE	60
STORAGE WATER HEATER - TO 30 GAL.	30
GAS REFRIGERATOR	4
CLOTHES DRYER	18
SPACE HEATING: HOT AIR (PER ROOM)	20
STEAM OR HOT WATER (PER ROOM)	30
LOAD FACTORS: DOMESTIC PLUS SPACE HEATING - USE 90% OF TOTAL SPACE HEATING ONLY - USE 100%	

FIG. 1. Estimated demand of gas appliances.

FLOW CAPACITY - CFH - SP. G. 0.70						
LENGTH IN FEET	STANDARD STRAIGHT STEEL PIPE					
	0.3" H_2O DROP		7.0" H_2O DROP		1/2 lb. DROP	
	1"	1 1/4"	1"	1 1/4"	3/4"	1"
10	270	490	1270	2390	880	1900
20	240	440	1130	2100	790	1650
30	210	385	1010	1850	700	1420
40	180	332	885	1600	610	1225
50	162	295	785	1440	540	1100
60		270	710	1300	490	1010
70		250	660	1200	460	935
80		234	615	1130	430	880
90		220	580	1070	405	825
100		210	555	1000	385	780
120		190	505	925	348	710
140			470	860	322	660
160			440	800	300	615
180			415	750	285	580
200			390	715	270	550
250			350	639	240	493
300			320	580	220	448

FIG. 2. Steel pipe capacity.

1/2" W. C. PRESSURE DROP
SPECIFIC GRAVITY 0.65

EQUIVALENT FOOTAGE INCLUDED			
SIZE SERVICE	1 1/4"	1 1/2"	2"
TAP OPENING	2	2.5	3
STREET TEE	7.5	9	12
STREET ELL	4	5	6
STOP COCK	3	3.5	4
TOTAL	16.5	20.0	25.0

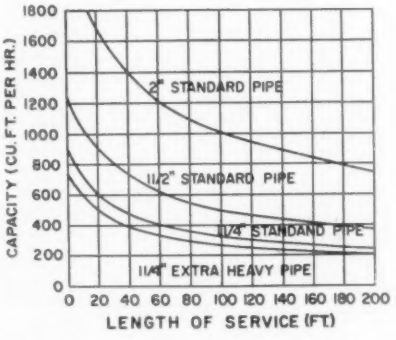


FIG. 3. Guide for sizing service pipe.

selecting the allowable pressure drop is to specify that it be some percentage of the main pressure during the maximum hour. One company selects a 20 per cent drop and another a 10 per cent drop. Still another method is to specify a value of 10 for the difference in squares of the absolute inlet and outlet pressures.

These various methods are basically to be used in sizing services which will supply large loads. Construction practices, availability of materials, and reduced inventory lead many companies to specify certain pipe sizes for services. In low pressure systems 1¼ in. pipe is generally preferred by most, although 1½ in. pipe is specified by about one-third.

In intermediate and high pressure systems the favorite minimum pipe size is ¾ in. with some 1 in. pipe specified for use in intermediate pressure systems. These "standard" sizes have been selected by the companies using them because they will provide adequate capacity to meet the more detailed requirements outlined in the preceding paragraphs.

Construction Specifications

Having selected a pipe size, the next problem is to design the construction specifications so that the service, when finally built, will conform to the established practice of the industry, comply with the applicable rules and regulations under which the company operates, and will be the safest and most economical service possible.

Several state regulatory commissions have recently enacted codes which govern in broad principles the design and construction of gas services. The gas industry, itself recognizing the need for a code or method of practice common to all parts of the country, has cooperated and assisted in the revision and expansion of Section 8 of the American Standards Associations Code for Pressure Piping. It might be well to review some of these standards.

The New York order adopted Nov. 7, 1952, requires that curb cocks be installed on all services where a regulator is installed on the customer's premises and on all low pressure services where large groups of people gather. It also provides for an annual inspection of these curb cocks.

The order also specifies that there be a program for periodic inspection and testing at reasonable intervals of house regulators and vents to see that they are operating properly and being vented safely. It also specifies that tamper-proof service cocks be installed on all services requiring a house regulator and that the same shall be inspected at reasonable intervals.

The Wisconsin interim code requires among other things that all house regulators operating at pressures greater than 10 psig shall be equipped with relief and breather vents terminating outside, and all regulators operating at pressures less than 10 psig shall have breather vents terminating outside. It also provides that the relief vent must be of sufficient size to relieve the whole capacity of the relief valve. It also requires that underground piping for which there is no planned use should be disconnected from the gas supply by a valve or some other means.

The Public Housing Authority in its Bulletin No. L R-17, Part V, makes certain requirements concerning gas installations. It requires that the service pipe shall not be laid in the same trench with other utilities and that where possible it should be laid at a higher level than other utilities. It also requires that the service trench should be vented to minimize gas seepage. Service entrances should be made above the floor line where there is a slab floor or unused or concealed crawl space. It requires that the service pipe be adequately protected against the loosening of pipe joints or the breaking of the pipe by the means of swing joints or other positive methods.

In regard to venting the service

FLOW CAPACITY - CFH - TYPE "L" COPPER TUBING - SP.G. 0.70												
LENGTH IN FEET	0.3" H_2O DROP		0.5" H_2O DROP		7.0" H_2O DROP			1/2 lb. DROP			1 lb. DROP	
	1"	1 1/4"	1"	1 1/4"	3/4"	1"	1 1/4"	3/4"	1"	1 1/4"	1/2"	3/4"
10	290	530	384	685	730	1400	2550	1025	1980	3600	380	1460
20	250	455	332	590	630	1210	2200	900	1750	3100	325	1250
30	220	395	287	520	550	1070	1900	770	1500	2700	285	1100
40	190	345	252	450	475	930	1650	675	1310	2325	248	950
50	170	308	223	400	430	830	1480	600	1160	2080	220	865
60		280	205	367	395	760	1350	545	1060	1900	200	780
70		260	190	340	360	700	1250	510	980	1750	185	725
80		244	178	319	340	660	1160	475	925	1640	173	675
90		230		298	320	620	1100	447	870	1550		640
100		219		282	300	590	1050	422	815	1475		610

FIG. 4. Copper tubing capacity.

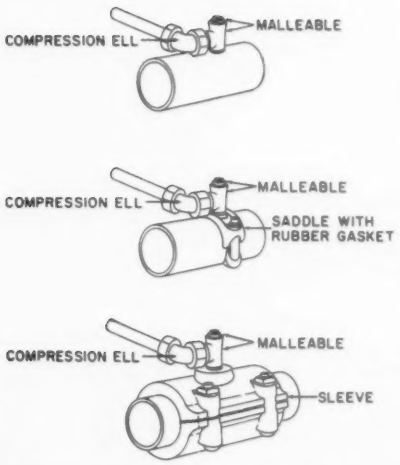


FIG. 5. Typical cast iron main connections.

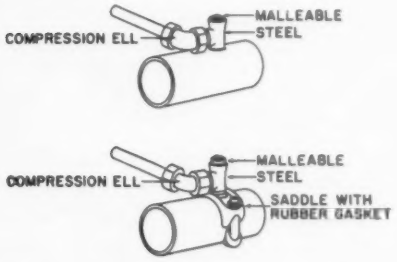


FIG. 6. Typical steel main connections.

trench, it recommends a backfill of coarse gravel to within 6 or 12 in. of the grade and then a permeable top soil. This would seem to be rather extreme in that the gravel-soil interface presents another location for corrosion to occur unless adequate protection is provided at this point. Also the idea of waterproofing the wall for the entire area would indicate that perhaps the entire wall should be waterproofed.

The Factory Mutual Engineering Division, Associated Factory Mutual Fire Insurance Companies, Loss Prevention Bulletin No. 11.88, makes some recommendations concerning gas service entrances. In general it recommends an above grade entrance; and where a below grade entrance is required it recommends that the pipe should be encased.

ASA Piping Code

Section 8 of the American Standard Code for Pressure Piping (ASA B31.1-1955) deals with gas transmission and distribution piping. It was published in its present form approximately a year and a half ago. Its influence is just beginning to be felt in the industry.

This code undertakes to define and specify the minimum requirements of construction of gas piping from the inlet to a gathering system or the outlet of a manufacturing plant through all the intervening steps to the outlet of the customer's meter. It defines as a gas service that pipe which runs between a main and a meter. It also defines high pressure as being a pressure greater than that supplied to a customer's appliance.

The code recommends that main connections be made at the top or side. On steel mains connections may be made by welding or by using a service clamp or saddle; and on cast iron mains, connections may be made by drilling and tapping the main. The diameter of the tapped hole in cast iron pipe should not exceed 25 per cent of the nominal diameter of the pipe except that 1¼ in. taps are allowed in 4 in. pipe.

Concerning the service pipe, the code requires that steel pipe for all services less than 6 in. in diameter and that when cast iron is used for larger diameter services it should not extend through the building wall. Either welded joints or compression fittings should be used in all services. Cast iron pipe should never be threaded, but may be joined with caulked, mechanical, or flanged joints. A minimum cover of 12 in. in private property and 18 in. in streets and roads is specified for steel pipe.

Service Facilities

Service shutoffs should be installed upstream of the meter and/or regulator. Outside shutoffs shall be installed on services operating at a pressure greater than 10 psig, on all services 2 in. or larger, and on all services supplying buildings where large groups of people assemble.

Underground steel services when installed below grade through the outer wall shall be encased in a sleeve or otherwise protected. The pipe or casing should be sealed at the point of entry. When it is necessary that a steel service be installed under a building it must be encased in a gas-tight conduit extending into a normally accessible part of the building where it shall be sealed.

Service regulators shall have breather vents and relief vents when required. Such vents shall terminate outside in rain and insect proof fittings.

Twelve of the companies replying to the questionnaire are planning some revision in their service design, six already comply, and three have the code under study. Twenty-seven companies indicated no intention of revising their practice at the time they answered the questionnaire. At the time the questionnaire was mailed the code had been published less than six months, and many companies had not had the opportunity to look at it. Generally, the analysis of the replies of the questionnaire indicates that most of the companies comply with the code.

Main Connections

The principal variable in the decision as to the type of main connection to make with cast iron mains is the size of main. The size of main generally limits the size hole that may be drilled and tapped without some sort of reinforcement. Table II illustrates the most frequently specified maximum tap size for various size cast iron mains. Generally, it appears that with the exception of 4 in. cast iron pipe the maximum tap diameter is 25 per cent of the main diameter. For 4 in. pipe a 1¼ in. tap is found almost as frequently as the 1 in. tap.

When the size or condition of the main is such that a direct tap cannot

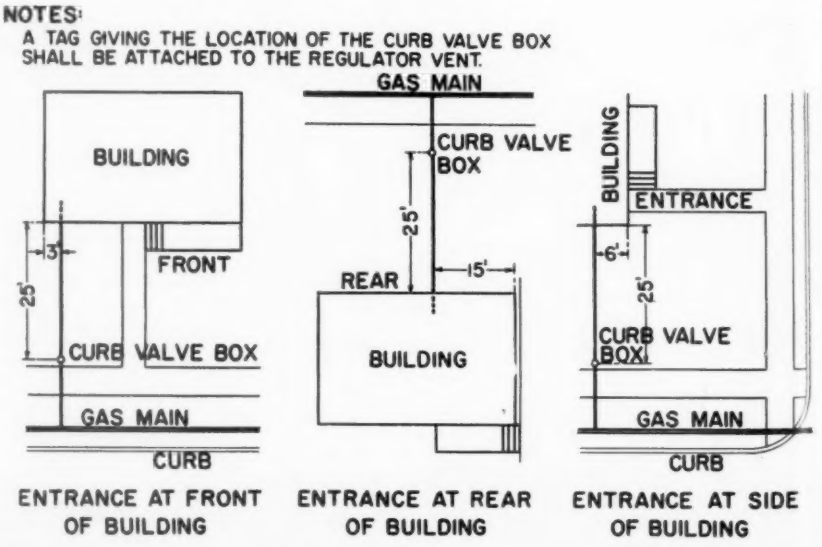


FIG. 7. Typical outside shutoff locations.

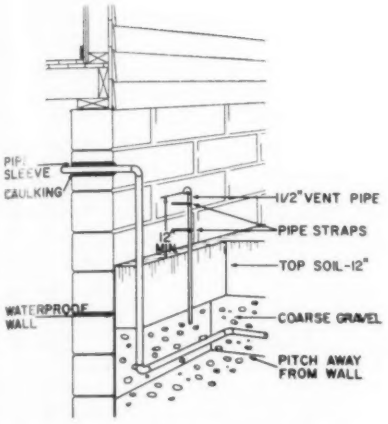


FIG. 8. Venting of service trench.

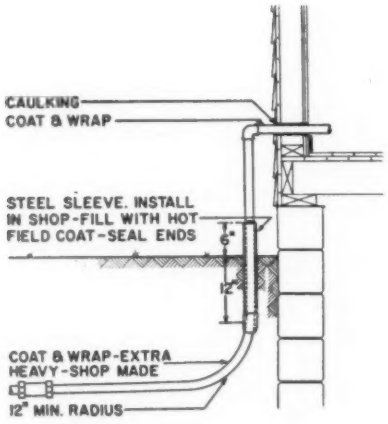


FIG. 9-A. Above grade service entrance.

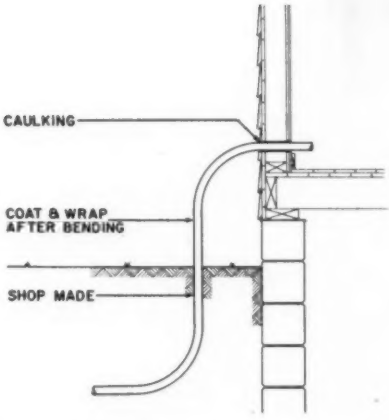


FIG. 9-B. Above grade service entrance.

be used, some means of reinforcement is required. The replies indicate that there is some slight preference for a clamp over a sleeve. Six of the companies indicate that they would cut in a tee if a tap greater than the allowed size was required.

The connection is then made with either a street tee or elbow to the service pipe, with a preference for a street tee. The branch of the tee then provides the point of connection to the service. Approximately 52 per cent made use of a single swing joint while 16 per cent made some type of rigid connection. The favorite material for these fittings is malleable iron although eight companies reported the use of brass fittings. A wide range of preferences were exhibited for the various coating materials to be used for field application to these fittings. The favorite was a hot applied coal tar tape while grease, hot coal tar and plastic tapes ran a close second. Several of the companies indicated that no field coating was necessary to protect the fittings.

The main fittings are not usually insulated from the cast iron mains. Only 4 companies indicated that an effort was made to insulate the fittings from the main, while 13 insulated the fittings from the service pipe.

The replies were about equally divided as to whether or not shutoffs were incorporated in the main fittings. The major reason given for using shutoffs was that the mains were carrying several pounds in pressure in the downtown areas.

In answer to the question, as to whether the design of the main fittings varied with design pressure, 62 per cent said that it did not. Of the remaining 38 per cent, at higher pressures one-half incorporated some type of shutoff in the main fittings and the remainder made some change in the type of material used, or the method of assembly.

When tapping high pressure cast iron mains the tap size was considerably smaller than the maximum allowed. Twenty-seven per cent used the maximum tap that the fittings would accommodate, while ¼, ½, and ⅝ in. were each specified by 18 per cent.

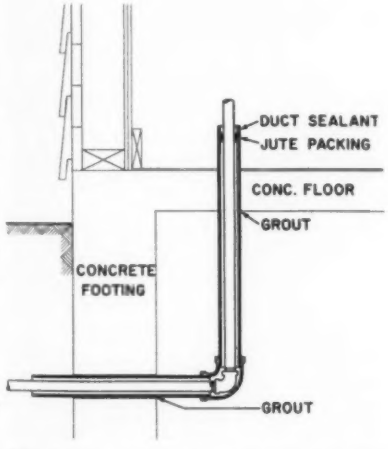


FIG. 10-A. Below grade service entrance.

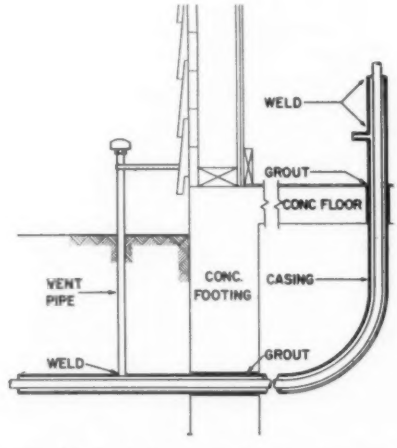


FIG. 10-B. Below grade service entrance.

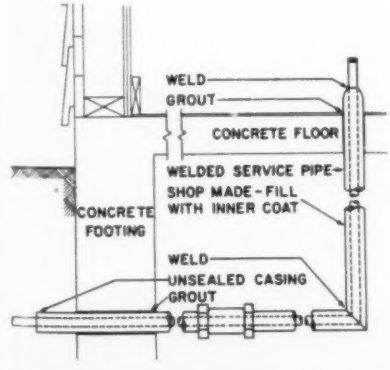


FIG. 10-C. Below grade service entrance.

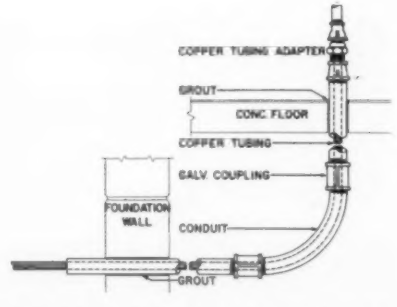


FIG. 10-D. Below grade service entrance.

Methods of Joining

In dealing with steel mains and services, welding appears to be the preferred method of joining. Since, however, it is not always possible for one reason or another, alternate methods are usually proposed. As an example, 46 out of 48 companies indicated that the main fittings are connected to the main by welding. As an alternative method, however, 16 companies use a saddle. All methods of making a joint are used on the main fittings: 31 use welded fittings, 27 use compression and 18 use screwed fittings. The effect of pressure on the design of the main connections is about equally divided

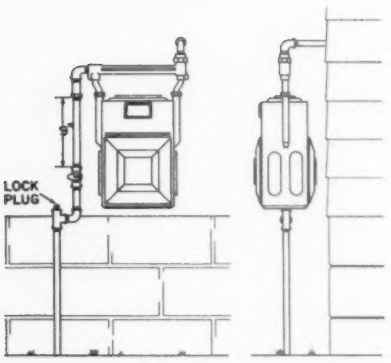


FIG. 11-A. Typical outside meter set.

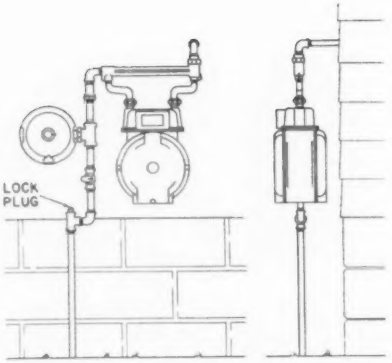


FIG. 11-B. Typical outside meter set.

between no effect (42 per cent) and some modification. Of the 58 per cent who did make some modification due to pressure, 30 per cent required welding on high pressure services and 42 per cent made some change in the design. As might be anticipated steel fittings were preferred by 2 to 1 among the various companies.

While 40 per cent of the companies did not incorporate a shutoff in the main fittings almost 72 per cent of the remaining 60 per cent did, and gave pressure as their reason. Similarly 47 per cent do not use a swing joint at the main and 75 per cent consider the main fittings to be electrically continuous with the main. Only 6 per cent make an effort to insulate the fittings from the main and 13 per cent make no effort to apply any electric insulation.

Twenty-six of the companies specified no maximum drill or tap size for high pressure services. Eight specified a maximum of ½ in.

How Pipe is Bought

Only 8 per cent of the companies install their main fittings bare or unprotected. The most frequently specified coating material is a hot applied coal tar tape followed close by hot coal tar enamel, plastic tape and grease. Forty-eight per cent specified the hot applied coal tar tape, 25 per cent specified the hot enamel, and the plastic tape and grease were each specified by 23 per cent of the companies.

According to the replies received, 60 per cent of the companies buy service pipe without any specification. Twenty-five per cent buy their pipe according to API-5L specification and the remaining 15 per cent are equally split between specifications A-53 and A-120. Eight of the companies specified butt welded pipe and 2 specified seamless pipe.

Generally there was no change in these specifications with the various type of construction. Only 8 of the companies indicate that they made any variation in the design. Similarly only 2 of the companies reported that they were giving any consideration to the use of thin wall steel pipe.

Since the service pipe is not continuous, lengths must be joined in some fashion. In the ordinary situations 71 per cent specify welding, 48 per cent compression and 37 per cent screwed fittings. Under improved roadways the percentage is more in favor of welded joints (79 per cent), while the percentage in favor of compression fittings drops to only 17 per cent, and the percentage specifying screwed fittings drops to 25 per cent.

The location of joints near the building wall is important since such joints are a potential source of leaking gas. While 44 per cent do not specify any minimum distance from the building wall, 21 per cent specify one pipe length and 10 per cent specify a 10-foot distance. However, none of the companies specify the use of lock type fittings for these joints.

Protection

Sixty-seven per cent of the companies specify the use of coal tar enamel coating on the service pipe. Approximately 54 per cent prefer a glass wrapper and the remainder use an asbestos felt wrap. The remaining 27 per cent are equally divided in favor of grease or asphalt while 10 per cent install the service pipe bare or with a galvanized metal coating.

The continued interest in cathodic protection is reflected by the use of electrically continuous joints in the service pipe. Welded joints are by their nature electrically continuous, armored gaskets are specified by 8 companies and 10 companies use bonds wires across the compression fittings to insure electric continuity.

Almost all of the companies own the entire service installation. Only 21 per cent report that they own service from the main to the property line. On rare instances services can be installed in the same trench as other utilities. If such an installation is necessary the gas service is usually installed on a bench or ledge above the other utilities.

At the main most, 29 per cent of the services are 24 in. deep. Thirty-seven per cent are 18 in. deep at the property line and 46 per cent are 18 in. deep at the building wall.

Some type of outside shutoff is required by all but one of the responding companies. Fifty-two per cent require outside shutoffs on all buildings and 37.5 per cent require shutoffs on all services to public buildings. Pressure is the criterion for 33 per cent of the companies and size of service for 29 per cent. Generally, services 2 in. in diameter and larger are equipped with outside shutoffs. Usually this shutoff is located between the street and sidewalk or at the property line, but where there is an outside meter set, the shutoff may be located above ground in the riser.

The plug valve is preferred for the outside shutoff, with the inverted key stop and the brass cock each used by the same number of companies. There appears, however, to be a change in preference due to either the pressure carried on the service or the diameter of the service. Forty-seven per cent of the companies indicate that the outside shutoffs should be provided with screwed connections. Only a third of the companies have a routine procedure for inspecting or operating outside shutoffs.

Building Entrances

Depending upon the design of the house and the gas service, the entrance into the building occurs either above or below ground. Mostly, the above ground entrance is associated with outside meter sets or basementless houses, and is not protected with anything other than the coating material. When the pipe enters the building wall it is protected either with a casing, or by being coated and wrapped. Some of the companies indicate that extra protection is unnecessary. Three of the companies install bare pipe.

The below ground entrance requires that a hole be drilled in the foundation wall large enough to accommodate the service pipe. After the pipe or casing is installed it is sealed into the building wall with either a cement grout, some type of caulking materials, or tar. Only 7 of the companies indicate that they make any effort to seal the exposed wall from any leaking gas. None of the companies make any planned effort to vent the service trench at the building wall except where it is completely under paving.

Present building construction is tending to the basementless or slab type of building. Approximately 30 per cent of the companies do not allow gas ser-

vice pipe to be installed in the crawl space or beneath the building. The remainder require that the service pipe be encased. Another way in which the problem can be circumvented is by running the pipe up the outside wall to the eaves, thence in the attic to the location of the drop to the meter set.

About one-half swing joints on the service. It is quite prevalent on inside risers. Cold bends are allowed by 69 per cent of the companies.

Most of the companies insist on running the gas service the shortest distance from the main to the house. Almost as many, however, will permit the use of laterals in laying the pipe. Approximately 50 per cent of the companies specify the minimum distance between the building wall and a parallel service pipe. One-third of these specify one foot as this minimum distance.

Meter Installations

Only 7 of the companies install no meters outside, while 19 install all of their meter outside. The remaining 22 indicate that they will make outside sets because of the construction of the house, the pressure on the service, or if the customer desires, an outside set. Many of the outside sets are protected by a metal, plastic or wooden box, although almost half are installed with no protection.

Almost all of the companies which indicated that they would make inside meter sets had the same specifications as to the location of the meter and its relation to other utilities, heating equipment, and accessible locations.

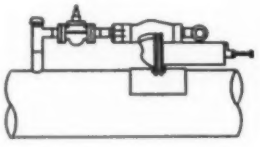
Both tin-case and hard-case meters are used by 48 per cent of the companies. Thirty-one per cent used only hard-case meters and 15 per cent use only tin case meters. The location of the meter, service pressure, and flow rate were three reasons given for specifying one type of meter over the other.

Generally, the meter piping is all screwed fittings and an insulating fitting is incorporated in this piping by 65 per cent of the companies. This insulating fitting serves to separate the gas piping from the other underground utilities. The iron body brass core stop cock is the preferred shutoff for meter set use.

Regulators

When the distribution pressure is such that a pressure regulator is required it generally is incorporated in the meter piping. Twenty-nine per cent of the companies allow a maximum pressure within a building of inches of water or 25 pounds per square inch. Generally, this service regulator has a ¾ in. body, an orifice from ¼ to ⅜ in. in diameter and about one-half are equipped with an internal relief valve. While most of the companies did not specify the type of relief, the ones which did were equally divided between mechanical and mercury seals.

At some pressure level two regulators are required to reduce the gas pressure to a utilization pressure. The companies are well distributed as to this maximum pressure, with some 62 per cent requiring double regulation when the pressure exceeds 50 psig. Since most of the companies do not permit a pressure greater than 25 psig inside the building, this first cut regulator must be located outside the house. The first cut regulator serves to cut the distribution pressure down to between 5 and 10 psig.



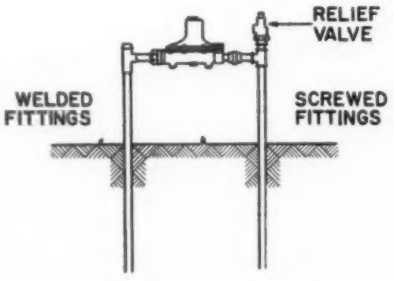


FIG. 12-A. Typical regulator installation.

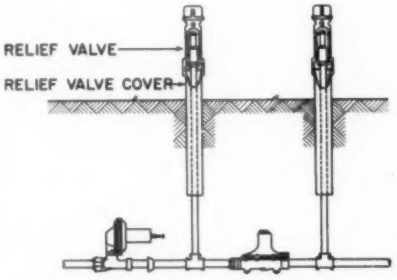


FIG. 12-B. Typical regulator installation.

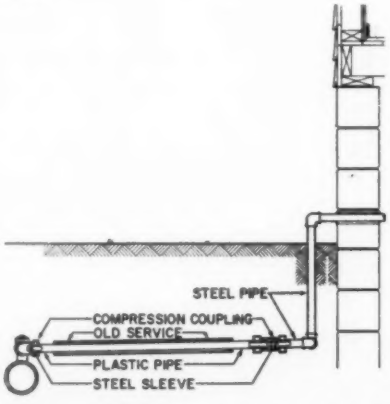


FIG. 13. Typical renewal by plastic insertion.

Relief valves are required on all services equipped with regulators by 50 per cent of the companies. Two companies install relief valves on services supplying public buildings. Sixteen of the companies use the pressure as the criterion for specifying the use of relief valves. Seven of these require relief valves when the pressure exceeds 5 psig.

Another safety device recently introduced is the pressure and/or temperature shutoff. One company reports the use of both types of shutoff while 6 use a pressure shutoff and 2 a temperature sensitive shutoff.

Other Materials

Many companies indicate that they are investigating the use of some material other than steel for service pipe. Increased economics of construction and a longer useful life are the anticipated benefits to be derived from these studies.

Copper has been used for several years by many companies for renewal by insertion in existing gas services. Some report they are using copper for new services where difficult construction problems are encountered. Generally, the copper is connected to steel pipe with compression adapters and sweated or soldered joints are made to connect lengths of copper tubing.

The recent developments in plastics has led many companies to investigate the use of plastics for both new services and service renewals by insertion methods. Most of the companies indicate that they are using a flexible type of plastic tubing although 1 or 2 report an experimental use of rigid tubing. Solvent welding is the preferred method of joining lengths of tubing and some type of plastic to steel adapter.

Service Maintenance

The final portion of the questionnaire dealt with service maintenance. Generally, the preferred method of preserving service information is keeping card files by location, usually showing a sketch of the installation and a bill of materials. Only 4 of the companies indicate that they have a formal program of service replacement. The age of the service, failure of the service, and leakage survey are the principal reasons for service replacement. There is very little agreement on the anticipated life of a service but most expect at least 40 years.

Acknowledgement

This article prepared from a talk given at the AGA Distribution, Motor Vehicle, and Corrosion Conference, Chicago, Illinois, 1956. ★ ★ ★

Automatic Smokeless Furnace Reconditions Steel Drums

Robert G. White
President
R. G. White Manufacturing Corporation, Ozone Park, New York

TWO problems have always plagued the steel drum reconditioning industry — slow, inefficient methods of removing drum residues, plus the volume of uncontrollable smoke that resulted when they were burned out.

Now, both problems have been solved with the introduction of an automatic, gas-fired furnace that processes steel drums and barrels, and also disposes of the fumes and smoke arising from the burn-out. The first unit is now in operation at Gold Cooperage, Newark, New Jersey, and additional machines are under construction.

Removal of drum residues has also been a hazardous operation, and with the advent of new chemicals and materials that defy conventional methods of removal, reconditioning has become even more troublesome.

Standard procedure was to stack the drums out in the open, douse them liberally with naptha or gasoline, and then set the entire pile aflame. Even though most of the drum materials were flammable, there was not enough concentrated heat directed into the drum interiors, and burn-out was unsatisfactory and incomplete. Additionally, dense black smoke would inundate the surrounding area, creating serious air contamination.

Drums are loaded into the furnace at this end and are processed at the rate of 115 per hour. Note that even though the furnace is operating, there is no smoke coming from the exhaust stack.

Similar Problem Sparked Idea

Through the Public Service Company of New Jersey, a solution to these problems was found by applying the same idea used in the design and construction of smokeless brake shoe de-bonding machines for automotive parts rebuilders. Here, burning is the only effective method of removing worn linings from brake shoes prior to re-lining. Similarly, manual burning-off methods also resulted in smoke — in many cases, the rebuilders were placed in difficulty with local air pollution authorities.

The brake shoe de-bonder burns off linings, cement and grease, and eliminates smoke by means of a built-in incinerator. The smokeless furnace designed for reconditioning drums at Gold Cooperage, although on a much larger scale, follows almost parallel engineering lines to the de-bonder and is equally effective in operation.

Steel drums, lids and rings are placed on a conveyor that carries them automatically through controlled heat zones and beneath the built-in fume incinerator. In the combustion chamber, high pressure gas burners (maximum 3,000,000 Btu input) ignite the combustible materials. Fumes and smoke are drawn up into the incinerator and are discharged into the atmosphere as clear, odorless gas.

Design Problems

In designing the furnace, the problem was one of combustion rather than mere heat input, inasmuch as most of the materials left in the drums were highly inflammable. Sufficient air had to be introduced into the furnace, and products of combustion exhausted at a fairly rapid rate to compensate for the amount of the various materials that remained — it is not uncommon for some drums to contain as much as 5 in. of materials, all of which must be removed.

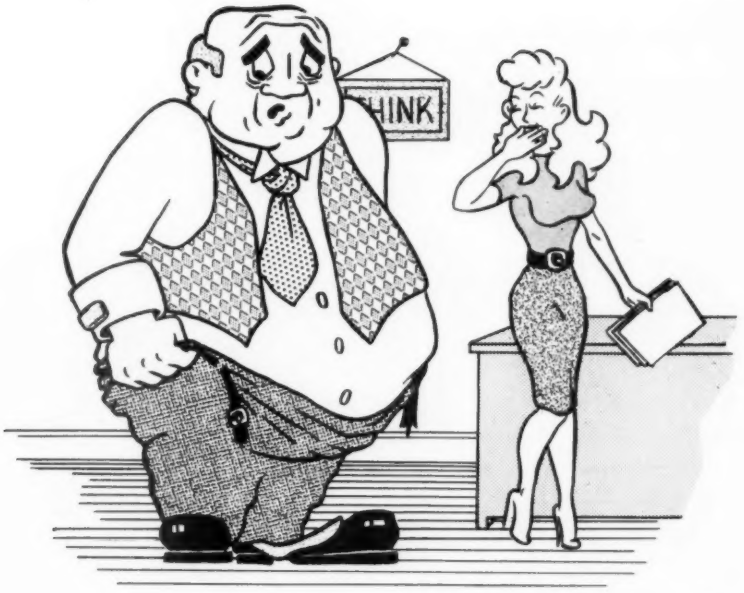
The furnace handles 115 drums and lids per hour regardless of previous contents. Residues of oil, grease, chemicals, plastics, paints, solvents, etc., are burned out so effectively that only a fine, carbonized ash remains. As a result, final cleaning by means of shot blasting is speeded up and simplified.

By controlling the conveyor speed and input of gas, drums that are excessively coated can be given a longer burning cycle. This is necessary, for example, in the reconditioning of drums used to ship undercoating, formerly one of the toughest materials to remove once it had hardened.

The machine is standard at 30 ft. long by 7 ft. wide and 12 ft. high, but can be made for any required production rate. Only two workmen are needed, one to load and the other to unload. Despite the size of the unit, it has proved economical to operate, net costs being 5 to 6 cents per drum. ★

Eighth of a series

Communication:



Problem arises.

Creative Thinking In Business

Dr. Dennis Murphy

SIR Henry Irving, the English actor, was once a witness for the prosecution in a criminal case. The defense attorney tried to browbeat and confuse him.

"At what hour," he asked, "did you see this occur?"

"I think —" began Sir Henry. The barrister interrupted with shouts.

"No one cares what you *think!* It's what you *know* that matters!"

"Don't you care to hear what I *think?*" asked the famous witness.

"We certainly do not!" snapped the lawyer.

"Then I may as well leave the witness box," said the actor. "I can't talk without thinking. I'm not a lawyer!"

Skill in communication includes many skills; thinking, observing, talking, listening, writing, and reading. But *thinking* comes first because it's basic to all the others.

What Is Creative Thinking?

James Harvey Robinson, the historian, recognized four types of thinking:

1. **Daydreaming, or reverie.**
2. **Making decisions.**
3. **Rationalizing to support what we already believe.**
4. **Thinking that causes us to change our minds.**

Logical thinking is an ability to draw sound conclusions from premises, to extract universal truth from individual cases, and to infer particulars from general laws. We use statistics, actual surveys, mathematical equations, valid reports, and relevent facts to help us in our reasoning processes.

But creative thinking — what is it? Someone said, "Talent is doing easily what others find difficult; genius is doing easily what seems impossible." Great creativity has been accounted for as biological variation that permits the achievement of great things without the awareness of it. And it occurs in varying degrees in individuals. According to Alex Osburn, all of us have the power to think creatively — women as well as men, the old as well as the young.

Whatever creative thinking is, it uses sensation, perception, imagination, intuition, and free association of impressions. Whether this thinking is derivative or accidental, it adds to our body of permanent knowledge and helps to solve our problems. As one quip goes, "Nothing is impossible — but some people are!"

Creative thinking in business and industry, as we use the term, does not imply the extraordinary genius that motivated Shakespeare, Mozart, or Einstein. It implies, rather, our ingenuity to produce unusual solutions to ordinary problems that baffle us on our jobs every day. It's more like the ability Ulysses used in getting himself out of "holes," or difficulties, in *The Odyssey*. It operates in all research, new ideas for production, decision-making, and problem-solving.

Where Do We Get New Ideas?

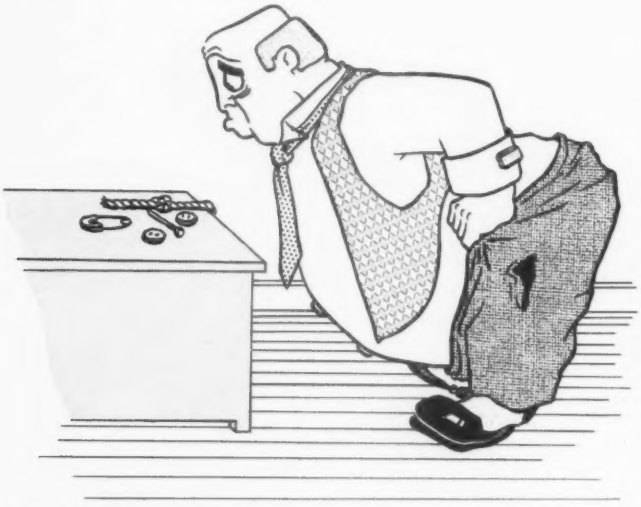
Edison said he got new ideas out of the air and distrusted calculated thinking. Hollis Thurston, the baseball scout who discovered Kiner, Minoso, Rivera, and other players, once said, "Like most scouts, I trust my first impression more than I do any later checks and balances."

Constantly we hear about individuals who have resolved their major problems abruptly out of the blue or seemingly without any logical decision. The late Louis Bromfield said, "I always trust the decisions of my inner-mind over any judgment arrived at through a long and reasonable process of conscious thinking."

Irving Langmuir, research chemist for many years with General Electric Laboratories, wrote: "In almost every scientific problem which I have succeeded in solving, even those that have involved days and months of work, the final solution has come to my mind by a process which is, consciously, not one of reasoning."

Someone once asked Henry Ford where his ideas came from. "The air is full of them," he said; "they are knocking on your head and you don't have to think about them too much. You only have to know what you want, then forget it and go about your business." In the same way, our best decisions will often burst through suddenly as if they were there all the time.

Apparently businessmen use their subconscious when they say, "I'm dead against selling this property — but don't ask me why!" or, "I'll have to sleep on it before I decide." During sleep our subconscious, released from the shackling intellect,



What to do?

can exercise freely. Undoubtedly too much mulling, reasoning, and calculating thwart our decision-making. And we know that many men unschooled in logic and reasoning have come up with some mighty fine decisions.

Can You Solve These Brain-Teasers?

An inventor has been defined as a fellow who doesn't take his formal education too seriously. In fact, too much formal education can cause mental blocking. Here are some "old chestnuts" you can test yourself on:

Problem 1 — Get a ping-pong ball out of a 2-inch rusty pipe 2 feet high and welded upright to the floor. (In the room are hammer, plyers, string, wire, fishhooks, a table, a crystal pitcher of ice water, a tumbler, and a chair.)

Problem 2 — Make four equilateral triangles by using 6 matches. (We visualize them in the same plane, can't get beyond our preconception, and grow frustrated by our mental block.)

Problem 3 — Drive a loaded truck through an underpass that lacks ½ inch of clearance. (Any old curb-sitter can tell you how!)

Problem 4 — Measure out 100 cc of water, a pitcher full, by using three containers holding 21, 127, and 3 cc.

Problem 5 — Measure out 20 cc of water from three jars of 23, 49, and 3 cc. (Many people needlessly use the 49-cc jar for this one!)

Problem 6 — Drive your car home after someone steals all six lugs off one of its wheels. (Maybe you've heard the joke about the inmate of an insane asylum who told his superintendent how to do this!)

Problem 7 — Connect all nine dots of a square by drawing four straight connected lines. You can't retrace or remove pencil from paper. (Don't fence yourself in!)

Problem 8 — Find the smallest number that can be divided evenly by 7, but leaves a remainder of 1 when divided by 2, 3, 4, 5, or 6. (There are several methods of arising at the right answer.)

Problem 9 — Discover what a suicide victim stood on to hang himself with a rope. (The room was barren — no table, chair, bench, box, or anything else in it. Only a large puddle of water on the floor.)

Problem 10 — John is 24. He is twice as old as Bill was when John was as old as Bill is now. How old is Bill?

The point of all this: Blocks to our creative thinking are caused by the way we **feel** about things (as in problems 1, 6, 9), the way we see things (problems 2, 3, 7) and the way we **think we ought** to go about things (problems 4, 5, 8, 10).

Psychologists have only recently begun to explore **how** and **why** we think as we do, but they have discovered some internal forces we overlook or shunt aside in our daily lives. And while we keep certain other impulses stored up in our cerebral cell-circuits, they often cause mental blocks that hamper adventurous thinking. Although we handle routine thinking well enough to get by, we rarely break out of our grooves of conventional thought.

Creative Thinking in Business

The main purpose of creative thinking in industrial research, of course, is to make money. New ideas should be stimulated in business to achieve maximum productivity, but they also have other values. Without underrating logical and judicial thinking, we need more creativity to help us (1) solve problems, (2) make decisions, (3) generate new ideas, and (4) vitalize work.

None of us knows too much about the living brain and its processes; and creative thinking is an activity to be learned rather than taught. But we know we can borrow and **adapt** ideas to new uses; **modify** ideas by giving them a new twist; **enlarge** an idea by adding other ideas to it; or **strip it down** by subtracting from or dividing it.

We also know we can change and **rearrange** the pattern; **reverse** certain elements; **substitute** this element for that one; and **combine** alien or foreign elements into a new composite. We also know we can leave a problem and come back, attacking it afresh from a different angle. And often we come up with the very idea needed — just in the nick of time. Many people do their best thinking under pressure. They have to!

All thinking is hard work, especially so if it's creative. We know, too, that its chief enemies are laziness and inertia, tradition and custom, ridicule and fear of being different from

Bright ideas!

others, lack of confidence in our abilities, and adherence to convention or conformity. Attitudes or I-don't-care and let-well-enough-alone are certainly no help. One mark of an educated man, said the psychologist, Albert Edward Wiggam, is that he never pooh-poohs anyone else's "wild" ideas or dreams.

One classic example occurred in 1867 when a boyish inventor tried to sell his idea of an air-brake to Cornelius Vanderbilt, then president of the New York Central.

"Do you mean to tell me you can stop a railroad by wind?"

"Since air is wind," said young George Westinghouse, "the answer is yes."

"Nonsense," roared Vanderbilt. "I have no time to waste on such a fool idea!"

Yet in a few years the Pennsylvania Railroad introduced the first automatic air-brake to the world.

Rudolf Flesch, in his *Art of Clear Thinking*, says that error is often more popular, attractive, and comfortable to believe than truth. Yet while we learn to combat the enemies of creative thinking, we also learn to offset the enemies of clear thinking.

Fundamental Steps in the Creative Process

1. **Recognition** of a need, change, or problem comes before any creative effort. If we sense no waste, for example, we're not very likely to originate anything that will eliminate waste.

2. **Preparation** consists of collecting the necessary information we must sort, arrange, and bring into play. We find new solutions in those areas we know most about; an industrial engineer, for example, is not expected to be creative in organic chemical research.

3. **Incubation** in the subconscious mind is important. Our conscious mind is the center of logical thinking because it deals with known ideas. But our subconscious mind, in moments of reverie and relaxation, sparks the new ideas.

4. **Illumination** is a sudden ray of solution, often fleeting and elusive, that we should jot down then and there or our conscious mind may never be able to recall it.

5. **Verification** through logical facts or experimentation is a crucial period in creativity. Here our open mind must reject all the conditioned thinking, stock responses, traditional experiences, and customary attitudes that have been built up in our logical mind.

What Companies Are Using Creativity?

Many organizations today are looking for ways to increase creative thinking not only among supervisors but also among those supervised. General Electric and Armour have active programs. MIT, USC, and other colleges offer courses in creativity; and the University of Chicago has psychologists who are studying the uses of intuitive thinking in industry.

An article in *Life* (May 16, 1955) by Morton M. Hunt, entitled "The Course Where Students Lose Earthly Shackles," tells about Professor John Arnold's course in Creative Engineering at MIT.

Of the 70 students who took this course in the past five years, over 20 now hold excellent jobs with firms like GM, IBM, GE, and Corning Glass and have rolled up a long list of original designs — from a special tractor to a new surgical instrument.

One company's adventures in "brainstorming" are described in an article by C. F. Hix and D. L. Purdy, called "Creativity Can Be Developed," in *General Electric Review* (May, 1955). The Education and Training Section for General Electric's many engineers has set up and developed a Creative Approach Seminar, a group that meets two hours a week for 16 weeks. It handles three groups a year.

Participants in this seminar discuss ways to improve old products and spark ideas for new ones. Leaving the judicial and critical portions of their thinking behind them, they work creatively and uninhibitedly toward a problem's solution. They also study many tested techniques that increase the flow of problem-solving ideas.

Members of this seminar recorded these stages in their approach:

1. **Recognize the problem — and write it down.**
2. **Define it by preparing specifications.**
3. **Search for as many solutions as possible.**
4. **Evaluate all of these carefully.**
5. **Select one and focus on it, the possible best one.**
6. **Make a preliminary design for it.**
7. **Demonstrate it.**
8. **Follow through by testing it.**

By the end of the seminar each member easily completes at least 20 ideas on a typical design problem. The group learns to use team techniques. A single "brainstorm" session causes 50 to 150 ideas to originate as fast as the men can write them down. One brainstorm produced 175 ideas in less than 30 minutes! If one idea out of 100 is usable, one out of 1000 is an improvement, and one out of 10,000 is an original "find" — the returns are considered tremendous. Maybe that's why GE's slogan is: "Progress is our most important product."

Petroleum scientists and engineers have come up with hundreds of new products and improved many others through research laboratories and modern techniques that stimulate creative thinking. Standard Oil Company (Indiana), for example, has groups of scientists who meet informally in creative sessions. Through "brainstorming" and other devices, these men "pop" new ideas all the faster because one idea sparks another.

The Ethyl Corporation also has an idea-generating program within its own organization and helps customer oil com-

panies in this new kind of service. Many other oil companies — and many companies in other industries — have creative research programs that allow young scientists and engineers to make specific contributions and build satisfying careers.

Anyone who visited General Motors Powerama saw a few of the practical results of creative thinking as they affect our living today and in the future. And, as Dr. Charles F. Kettering says, "We should all be interested in the future because that's where we're going to spend the rest of our lives."

What Can Management Do About It?

Many factors must be considered to determine the need and extent of creative research: Size of the company, the nature of its product or service, its competition in the market, its personnel, and so on. One company may survive on the creative ideas that its management can supply; another may need to stimulate a constant influx of new ideas.

Managers looking for newer and better ways of doing

Problem solved.

things have long used **suggestion boxes** or **cash awards.** In a company-wide suggestion system, employees are rewarded for money-saving ideas they suggest. But managers should administer cash awards with the utmost finesse, or they may create more problems than they can solve!

In the oil industry, especially, research is usually a group effort so highly complicated that management could hardly make cash awards on any equitable basis. Sometimes managers pay outside consultants to bring in new ideas, but they owe no extra money to inside research workers whose very job it is to generate ideas. Yet a company usually pays its men according to the ideas produced.

Often industry promotes the ingenious employee to a management job, at the same time smothering his imagination and inventiveness with the routine of statistics, system, and control. And while industry develops a few exceptional men, it neglects many who get trapped in a system that tends to suppress their potential talent.

Since creative talent is so highly valuable, all managers should keep an eye out for this valuable asset in human resources — the natural creativity in the **average** man. And first-line supervisors are in a much better position to observe it than top management!

With our growth in population and its greater demand for production from a smaller proportion of workers in the future, the pressure is on for increased output per man-hour. This step-up will call for new methods and manufacturing techniques. So, improvement is not a fad but a fundamental. Managers, then, must take creativity out of the realm of uncertainty and adopt new attitudes toward it. They must realize that time spent on new ideas is time profitably spent.

Communication Is the Key

Dr. Norman Vincent Peale defines creative thinking as healthy thinking that will improve our conditions. Employees **do** have fresh ideas and **are** interested in improvements. Everyone likes to improve; that's the nature of men. And all employees find their greatest pleasure when they can think, improve, communicate, and produce with others.

How can management stimulate the right atmosphere so that creativity can emerge and thrive usefully?

1. *Encourage free and informal communication among all levels.*
2. *Discourage the "crash" or emergency approach in solving problems.*
3. *Develop optimistic attitudes instead of complacent and negative ones.*
4. *Question any policy of promotion that may stifle creativity.*
5. *Encourage new points of view through every form of communication — especially in creative research seminars that cut through all levels.*

Creativity in a company rests largely upon: (1) the friendly freedom to think up and talk up to others, (2) the interchange of ideas among men with a variety of backgrounds and experiences so they can stimulate and assist each other, and (3) the free-flow communication that allows each employee to contribute his best. Workers like to contribute new ideas and experience a sense of contributing. Training programs fizzle out when the participants themselves aren't consulted about the kind of training they desire and need.

What does all this mean to the manager? He must turn to the techniques of joint action and participation if he wants to effect creative thinking. Democracy in business depends on a fundamental faith and belief in employees. Each manager must find releases for their latent talents and abilities for worthwhile purposes if he is to utilize the full human potential and human resources at his command.

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Glossary of Gas Industry Terms—Dr to Ga

Drill Pipe: In rotary well drilling, the rigid pipe connection between the collar of the drill at the working level, and the rotary table on the derrick platform. In addition to transmitting the driving power to the drill bit, the open drill pipe is used to force mud to and through the perforated drill bit for the purpose of picking up the cuttings so that they can be washed to the surface and removed.

Drilling: The mechanical operation of exploring for subsurface reservoirs of gas and oil for the purpose of production to the earth's surface.

Drip: A low collection point installed in a gas line to which liquids, such as condensation, tend to flow and from which they cannot return to the pipe, but are discharged automatically or drained by a manually-operated valve.

Drip Box: A square or round box around a drip that protects the drip and pipe but allows access thereto.

Drip Pot: A container into which liquids or condensate flows. Connected to low point in pipe lines.

Drip Pump: Pump used to empty drip pot.

Drip Riser: Also drip stand pipe, small pipe connecting drip pot with ground level.

Dry Gas: Natural gas obtained from sands that produce gas only.

Dry Natural Gas: Natural gas that does not contain crude petroleum or condensate, or gas from which the liquids have been removed.

Dry Purification: The removal of impurities from a gas by passing it through a dry bed of solids that filters the impurities, absorbs or adsorbs them.

Dry Steam: Steam that contains no liquid water particles.

Duct: A tube or pipe, completely enclosed, for the flow of fluid.

Dust Catcher: Equipment for removal of dust particles from gas or air.

E

Easement: A formal permission granted by landowners for laying and maintaining a gas pipe line.

Economizer: Equipment, such as is placed in a flue, for the purpose of utilizing waste heat in the flue gases to preheat boiler feed water.

Edge Water: Subsurface water that holds gas and oil in the higher positions of reservoir structures.

Edward's Balance: A balance for determining the specific gravity of gases.

Efficiency: A percentage expression of the available Btu input that is absorbed for useful purposes. It is applied, generally, to combustion equipment.

Efflux: The rate of flow out of a vessel or from an orifice.

Effusion: The exit or exhaust of a gas through an orifice.

Effusion Method of Specific Gravity: A means of determining the specific gravity of a gas by comparing the times required for the exit or effusion of the gas through a standard orifice with the time for air.

Elasticity: In gases, their power to recover their former volume after release from compression.

Elbow: A pipe fitting that makes an angle in a pipe-run. Unless stated otherwise, the angle is usually assumed to be 90 deg.

Electric Heat Energy: Available heat in electricity; one kilowatt hour is the equivalent of 3412 Btu.

Electric Log: An electric device that is used in determining the nature of a subsurface formation.

Electrolysis: In a pipe line, the decomposition or destruction of the pipe wall by stray electrical currents.

Electron: A negatively-charged particle that is a constituent of every atom of matter.

Emanation: Gaseous discharge, or the flowing forth of fluid as from a well.

Emissivity: The degree of energy radiation from a surface compared with the radiation from a black body.

Endothermic: Heat absorbing. An endothermic reaction is one in which heat is absorbed as in the expansion of a gas or in the evaporation of gasoline.

Endothermic Reaction: A reaction in which heat is absorbed; opposite of exothermic reaction.

Engine (Carbureting): An internal combustion engine using liquid fuels, the fuels being atomized or vaporized in a device external to the engine known as a carburetor.

Engine (Gas): An internal combustion engine using gas as a fuel.

Enrichment: The process of mixing a gas that has a relatively high heating value with another gas that has a lower value to raise the value of the latter gas.

Equilibrium: The point at which a mass, usually considering a furnace wall, has absorbed the maximum heat that can be retained at that source temperature. Beyond that point, heat input to the mass will result in a transfer of the same amount of heat through the mass or wall.

Estimated Bill: A customer's bill for gas that is estimated, based on previous consumption, rather than based on meter-reading.

Ethane: A hydrocarbon component of gas.

Ether, Petroleum: A group of the most volatile hydrocarbons obtained from natural gas far from the distillation of petroleum. Used as a solvent and as a local anesthetic.

Ethylene: A hydrocarbon and an illuminant that is a component of manufactured gas.

Eudiometer: An instrument for the volumetric measurement and analysis of gases.

Evaporate: The process in which a liquid is changed to a vapor by exposure to heat.

Evaporation Loss: The loss of fluid volume or weight due to the time evaporation of the fluid. It varies with the temperature, the amount of fluid surface exposed, the boiling temperature of the fluid, the velocity of air over the surface exposed, and tightness of tank.

Evaporator: Equipment or device that extracts or drives out liquids from solutions or gases. Also, equipment that is part of refrigerating systems to permit liquid refrigerants to evaporate in the process of dispelling absorbed heat.

Excess Air: The volume of air supplied to a combustion chamber or system that is beyond the requirements for complete combustion of the fuel.

Exhaust Port: In side-valves, the openings through which a fluid passes out. In gas meters, the openings through which gas leaves the meters.

Exit Temperature: The flue gas temperature taken at the point where the gas leaves the combustion chamber.

Exothermic Reaction: A chemical reaction, such as fuel combustion, in which heat is liberated.

Expansion Gas: The increase in volume of a gas due to changes in temperature or pressure.

Expansion Joint: A provision, usually in piping, that accommodates the mechanical movement set up by contraction and expansion due to temperature changes in the piping system.

Expansion Loop: Either a bend like the letter "U" or a coil in a line of pipe to provide for expansion or contraction.

Expansion Polytropic: A class of gaseous expansion taking place approximately in heat engines and expressed by "PV" equal constant.

Expansion Ratio: The ratio of the gas volume after expansion to the gas volume before expansion.

Expansion Ring: A hoop or ring of U-section used to join lengths of pipe to permit expansion.

Expansion Valve: A special valve used in refrigerating systems through which the liquefied gas (under high pressure) is allowed to escape into a lower pressure and thus expand into a gas.

Exploration: The work that is involved in searching for subsurface reservoirs of gas and oil, preparatory to drilling for production purposes.

Explosion Head: A term applied to a protective device that is arranged to blow out a disk, usually, if an air-gas mixture explodes in a piping system. Thereafter, the gas will escape until a shut-off valve is closed.

Explosion Ratio: The ratio of the air to the vaporized fuel. The ratio of the explosion pressure to the compression pressure.

Explosive Limit: The high and low proportions of air-gas mixtures within which the mixtures are explosive when ignited.

External Producer: A source of fuel gas that supplies gas to coal gas retorts or coke ovens from a separated location.

Extra Heavy: When applied to pipe, means pipe thicker than standard pipe, when applied to valve and fittings indicates goods suitable for a working pressure of 250 lb per sq in.

Extra Strong: The term or name for a certain class of pipe that is heavier than standard pipe and not as heavy as double extra strong pipe.

Extraction: The process of separating with solvents, by distillation, by mechanical equipment of components of a fluid to obtain them for use or to remove impurities.

Extractor: Mechanical equipment used to remove impurities from gas; usually applied to manufactured gas.

F

Factor of Safety: A number showing the ratio of the actual breaking strength of a material to the safe load that the material should support.

Fahrenheit: Temperature scale commonly used in U.S.A. in which water freezes at 32 F and boils at 212 F at normal atmospheric pressure.

Falling Seam: A depression along a weld on the outside of a butt-welded pipe.

Fan Blower or Booster: See: Blower.

Fan Mixer: A fan or blower to which gas is admitted to mix with air.

Fat Gas: See: Wet Gas.

Fault: An underground fracture or slippage of rock that has brought a permeable or porous layer of rock into lateral contact with an impermeable layer, thereby trapping any gas or oil moving through the permeable rock at the line of the fault.

Fe: Chemical symbol for iron.

Federal Power Commission: An agency of the government of the United States that has jurisdiction over the construction, operation and rates of interstate natural gas pipe lines that sell gas for resale. With respect to the gas industry, the general regulatory principles of FPC are defined in the Natural Gas Act, as amended.

Feed: Raw materials fed into a piece of equipment.

Feed Points: Connections between gas feeder lines and distribution networks in local gas distribution.

Feed Water: Water fed to a boiler for conversion to steam, consisting of condensed exhaust steam and make-up water to replace losses of steam.

Feed Water Heater: A heat exchanger heated by direct fires, hot flue gases, or steam and used to preheat the feed water before it is sent to the boiler.

Feed Water Pump: A pump for forcing feed water into a boiler against the steam pressure within the boiler.

Feed Water Treatment: The removal of materials causing boiler scale from boiler feed water by chemical treatment.

Feeder (Feeder Main): A comparatively large size gas pipe that delivers gas from the city gate or the gas holder to the distribution networks or grids.

Ferric: Chemically, a specific form of iron in a chemical compound in which the iron is trivalent.

Ferrous: Containing iron, a general term; chemically, a specific form of iron in a chemical compound in which the iron is bivalent.

Féry Pyrometer: Temperature measuring instrument in which radiation from heat source is focused on a small thermocouple and the resulting current generated read on a galvanometer scale calibrated in degrees of temperature of the heat source.

Field Mains: Pipes transporting natural gas from individual wells to processing point, compressor stations or transmission pipe line.

Field Pressure: The pressure of natural gas as it is found in the underground formations from which it is produced.

Fillet Weld: An approximately triangular cross-section weld resulting when two surfaces, more or less at right angles to each other, are welded together.

Filter: A mechanical means of removing solid materials from a liquid or gas; so constructed that the fluid passes through the filter and the solids are held back.

Filter Aid: Finely-divided solid or fibrous material used to increase the speed and efficiency of filtering.

Fin-fan Cooler: A dry cooler that passes cooling air over finned tubes through which some hot fluid is being passed during the cooling processes. A variable speed fan is used to regulate movement of air over the finned tubes.

Fire: In boiler or furnace operation, the act of feeding fuel to the furnace whether by hand or mechanically.

Fire Box: The space within a furnace in which fuel combustion takes place.

Fire Brick: Fire resistant material formed into bricks and used to line fire boxes of boilers, furnaces or other combustion chambers.

Fire Brick Arch: An arch built of fire brick, within a fire box, to aid in complete combustion of fuel and radiation of the flame heat.

Fire Clay: A special kind of clay that will not melt or fuse at high temperatures.

Fire Damp: A combustible gas or damp formed by the decomposition of coal or other carbonaceous matter, and consisting chiefly of methane; also an explosive mixture and air, exploding upon ignition when mixed with atmospheric air.

Fire Door: In hand-fired furnaces, the door through which fuel is fed to the fire. The same as the clean-out door in other furnaces.

Fire Point: Minimum temperature at which a substance will continue to burn after being ignited.

Fire Valve: A safety valve installed at the inlet of gas meters set inside buildings and so designed that the gas supply will be shut off when the valve is heated to a certain temperature.

Firing Rate: The rate at which fuel or an air fuel mixture is fed to a burner; expressed as volume, heat units or weight per unit time.

Fischer-tropsch Process: Hydrogenation of water gas (produced from reaction of coal, lignite or petroleum hydrocarbon and steam) at 1-10 atmospheres pressure and 360 to 410 F to obtain fluid and gaseous fuels and paraffin wax.

Fishtail Burner: A tip for a gas burner that produces a wide flat flame that is somewhat fishtail shaped.

Fitting: A device, usually metal, for joining lengths of pipe into various piping systems; including valves, couplings, ells, tees, crosses, reducers, unions, caps, and drips.

Five Light Meter: The smallest size gas meter usually installed for a domestic consumer.

Fixation, Fixing: The application of heat to transform an oil vapor into a gas.

Fixed Ammonia Compounds: Chemical compounds of ammonia from which the ammonia cannot be driven by heat alone.

Fixed (Residue) Carbon: The remainder of coal after deducting for the volatile matter, moisture, and ash.

Fixing Chamber: A heated checker chamber, the last through which gas passes in the manufacture of hi-Btu oil gas, and in which the gas is further cracked and stabilized.

Flame Descaling: Removal of scale from steel by differential expansion caused by very rapid heating with a gas or oxy-acetylene torch.

Flame Front: The base of a flame at which combustion starts.

Flame Priming: Heating of steel surface with a gas torch to remove scale, moisture and rust before painting.

Flame Propagation: The rate at which a flame will travel through a combustible mixture of fuel and air.

Flame Retention Burner: A burner so constructed that the main burner nozzle is surrounded by small pilot light ports that will re-ignite the main nozzle in case the flame is blown out.

Flame Temperature: The maximum temperature of a flame, measured in degrees of Fahrenheit or Centigrade.

Flame Velocity: The speed at which flame progresses through a fuel-air mixture.

Flame Welding: Welding with an oxy-acetylene or gas torch as distinguished from electric arc welding.

Flange: A plate of material set at right angles to the surface to which it is attached and usually used to fasten two sections of material together.

Flange Pipe: Pipe with flanges attached so that the ends of pipe sections can be bolted together.

Flange Union: A fitting consisting of a pair of flanges and bolts to connect them for use on threaded pipe.

Flanged Joint: A joint in pipes made by flanges bolted together.

Flank Drilling: The drilling operation at the currently known limits of existing gas or oil fields.

Flare: Burning of gas from a gas well or from a gas-oil separator, for the purpose of safe disposal.

Flash Back: The burning of gas in the mixing chamber of a burner, or in a piping system, due to an excess of primary air or to slowness of gas flow.

Flash Point: The minimum temperature at which the vapors above a liquid fuel can be ignited by an open flame.

Flat Flame Burner: A burner so designed that it produces a wide flat flame.

Flexible Coupling: A mechanical connection between two pieces of machinery or two pipes to allow movement of the two parts independent of each other.

Flexible Gas Hose: A flexible pipe or hose for attaching a gas appliance to a rigid gas outlet pipe.

Floating Flame (Flame Blow-off): A flame that burns above the burner tip with a section of unburned gas between; caused by too great a gas velocity out of the burner tip.

Floating Tank: A water tank suspended within a hot water heater shell so that the hot gases of combustion pass between the tank and the shell to heat the water.

Floor Furnace: A furnace mounted in the floor and suspended between the floor beams. Supplies warm air heat through a grill in the floor on top of furnace and does not require air ducts.

Flow Coefficient: A factor used in computing the rate of flow of a fluid through an orifice.

Flow Formula: In the gas industry, a physical formula for determining the flow of gas between any two points in a pipe line under various conditions.

Flow-nipple: A short piece of pipe the same size outside of the flow line connections but bored to a much smaller size to restrict the flow, used to control a flowing well.

Flowing Plant: A name sometimes applied to a compression plant where air or gas is compressed for the purpose of the gas lift method of pumping a well.

Flowing Well (Oil): One in which oil flows at the surface due to the natural underground pressures.

Flow Meter: A device for measuring the rate of flow of a fluid.

Flue: A pipe for carrying hot combustion gases out of a combustion chamber to the atmosphere, or to a heat exchanger.

Flue Gas: The gases from the fire or the products of combustion consisting principally of carbon dioxide, carbon monoxide, oxygen and nitrogen. Boiler tests for combustion efficiency depend upon flue gas analysis.

Flue Gas Analysis: A quantitative analysis of the various components in flue gas, expressed generally in percentages of volume.

Flue Gas Loss (Stack Loss): The sum of the sensible heat in dry flue gas plus the sensible and latent heat in the water vapor it contains.

Flue Gases: The gases resulting from combustion of a fuel.

Fluid: A non-solid substance or material that will flow, such as gas or liquid.

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Fluidity: The ease with which a fluid substance will flow.

Fly-ash: Fine particles of ash that are deposited within a furnace or rise through the chimney flue to the surrounding atmosphere.

Foaming: The formation of a mass of relatively stable bubbles on the surface of a liquid.

Fold: In geology, an uplifting and bending of rock strata due to earth movement, resulting in a wrinkle or fold in the strata. May serve as a trap for gas and petroleum.

Forced Draft: The blowing of combustion air into a combustion chamber, thereby forcing a draft through it.

Foreign Structures: With respect to gas mains, the water and sewer pipes, telephone, telegraph and electric cables buried under city streets.

Formation: A geological term applied to an underground stratum; in the gas industry, usually the one from which gas or oil is produced.

45 deg Bend or Ell: A fitting for connecting two sections of pipe together at a 45 deg angle to each other.

F.O.T. Efficiency: Fuel-oil-tar efficiency. The efficiency of a carbureted water gas plant, measured as the ratio of the heating value of the gas and tar produced to the heating value of the fuel and oil consumed, per unit volume of gas produced.

Foul Gas: Unpurified manufactured gas.

Foul Main: The pipe carrying gas to the purifying section of a manufactured gas plant.

Fouled Oxide: Iron oxide used in purifying manufactured gas that has absorbed all impurities, chiefly hydrogen sulfide, that it can hold.

Foundry Coke: A grade of coke especially adaptable to the making of cast iron.

Free Ammonia: Ammonia in combination with other materials from which it can be driven by the application of heat.

Friction Factor: A factor used to compute the decrease in pressure and flow due to friction of a fluid flowing through a pipe.

Fuel: A substance that will burn under controllable conditions furnishing heat in a usable form.

Fuel-air Ratio: The ratio of the rate of fuel supply to the rate of air supply required to obtain the desired combustion characteristic.

Fuel Bed: In the case of solid fuels, the mass of fuel on the grate of a furnace.

Fuel Clause: A provision in a manufactured gas sales contract that allows an increase or decrease in the gas price as the price of fuel used to make the gas goes above or below the fuel price set in the contract.

Fuel Efficiency: The percentage of total heat input that is utilized for work in any given operation involving the burning of a fuel.

Fuel Gas: Gas used for heating, lighting, power, etc., as distinguished from gas used in the manufacture of gasoline. Residue gas from a natural gasoline factory.

Fuel Oil: Oil that can be used as a fuel in properly designed and operated equipment.

Fuel Ratio: The amount of heating capacity in a fuel as compared with another fuel taken as a standard.

Fuel Resources, National: The national totals of the natural underground deposits of solid, liquid and gaseous fuels; also the potential electric generation from water power, available for production throughout the United States for useful purposes. The totals may be expressed in terms of the unit of measure for each source of energy or those units may be converted to the common unit, the therm (100,000 Btu).

Fuel Value: A measure of the amount of heat available from the combustion of a unit weight or unit volume of a fuel. Usually expressed as Btu per pound or per cubic foot.

Full-automatic Cut-off Protection: An automatic control on a gas-using appliance that shuts off the gas to the unit if the pilot flame goes out.

Furnace: A piece of equipment for the controlled-combustion of a fuel.

Furnace Black: Carbon black manufactured by the partial combustion or thermal decomposition of natural gas or other hydrocarbons in a furnace with a limited supply of air to prevent complete combustion.

Furnace Pressure: The pressure existing within the combustion chamber of a furnace. It may be positive if it is greater than atmospheric pressure, negative if less and neutral if the same.

Fuse: The melting or partial melting followed by joining of normally separated material into a larger mass. To join adjacent edges of sheet material by melting them together.

Fusing or Melting Point: The temperature at which a solid substance will melt.

Fusion Point: The temperature at which a substance can exist in a solid and liquid state in equilibrium.

G

Gage: In the gas industry, indicating or recording devices that measure such gas characteristics as temperature, pressure or flow rate.

Gage Glass: A glass tube set on the outside of a tank or boiler, connected into the tank with one or more gage cocks, used to indicate the internal liquid level.

Gage Pressure: The pressure measured in excess of the pressure exerted by the atmosphere. See: Absolute pressure.

Gager: A person who measures the contents of tanks of liquids such as oil, gasoline and liquefied petroleum gas.

Gallery: The top space, above the diaphragm chambers, in a tin case gas meter.

Galling: The peeling or stripping of pipe threads.

Gallon: A U.S. gallon contains 231 cu in. A U.S. gallon of distilled water at its maximum density and 30 in. of mercury barometric pressure weighs 8.3389 pounds avoirdupois.

Galvanized Steel Pipe: Zinc coated steel pipe in which the zinc retards corrosion.

GAMA: Abbreviation of Gas Appliance Manufacturers Association.

Gang: A crew of workmen of any size.

Gang Pusher: A supervisor in charge of a work gang.

Gantry: A traveling crane with tracks at ground or floor level and on legs high enough for the crane to carry a load over the tops of obstructions.

Gas: An aeroform that has neither independent shape or volume. It is one of the three forms of matter: solid, liquid, and gaseous.

Gas Absorption: Taking up of gas by another material.

Gas, Acetylene: An unsaturated hydrocarbon colorless gas of garlic odor, slightly soluble in water but soluble in alcohol.

Gas, Aerogene: A fuel gas obtained by carbureting air with gasoline.

Gas-air Drive: The injection of a mixture of gas and air into oil sands to increase the production of oil.

Gas Bag: A gas-proof, inflatable bag that can be inserted in a gas pipe and inflated to seal off the flow of gas in the pipe.

Gas Balance: An instrument for determining the weight of a gas; i.e., its gas gravity.

Gas Black: See Carbon black.

Gas, Blast Furnace: Gas obtained from the waste gases issuing from blast furnaces. It is very lean and can only be burned successfully within the cylinders of a gas engine.

Gas Booster: A blower or compressor used to increase the pressure in a gas system.

Part 4 of Gas Fundamentals will appear in the next issue.

CALENDAR OF THE GAS INDUSTRY

JULY-1956

9-11 AGA, API, CPA committees on natural gas reserves, Banff, Canada.
9-13 National housewares and home appliance manufacturers exhibits, Atlantic City, New Jersey.
9-Aug. 8 Gas Technology Short Course, North Carolina State College, Raleigh, North Carolina.
16-20 Western summer radio-television and appliance market, Western Merchandise Mart, San Francisco.
24-27 NARUC annual convention, Shearton Palace Hotel, San Francisco, California.

AUGUST 1956

27-29 Annual Appalachian gas measurement short course, West Virginia University, Morgantown, West Virginia.

SEPTEMBER 1956

4- 7 AGA operating section, organization meetings, Hotel Cleveland, Cleveland, Ohio.
7 New Jersey Gas Association, 41st annual meeting, Spring Lake, New Jersey.
10-11 Independent Natural Gas Association of America, San Antonio, Texas.
11 NEGA safety conference, Hotel Statler, Boston.
11-13 PCGA annual meeting, Hotel del Coronado, Coronado, California.
12-14 MidWest Gas Association, gas school and conference, Iowa State College, Ames, Iowa.
13-14 AGA-EEI accounting section organizational meeting, Edgewater Beach Hotel, Chicago, Illinois.
14 NEGA CHI division, Wachusett Country Club, Wachusett, Massachusetts.
14 AGA personnel committee, headquarters.
14-15 Maryland Utilities Association, 32nd fall conference, The Cavalier Hotel, Virginia Beach, Virginia.
17 AGA accident prevention committee, Shirley-Savoy Hotel, Denver, Colorado.
17-20 American Transit Association, Jefferson Hotel, St. Louis, Missouri.
18-19 AGA accident prevention conference, Shirley-Savoy Hotel, Denver, Colorado.
19-21 Southeastern Gas Association, Hotel Sir Walter, Raleigh, North Carolina.
19-21 American Trade Association, Executives, annual meeting, Plaza Hotel, New York City.
30-Oct. 3 Controllers Institute of America, Waldorf Astoria, New York City.

OCTOBER 1956

4 NEGA, appliance servicing conference, Hotel Statler, Boston.
8-12 National Metal Exposition, Cleveland, Ohio, (AGA will exhibit.)
9-12 The American Dietetic Association, Milwaukee, Wisconsin.
15-17 AGA annual convention, Atlantic City, New Jersey.
15-19 National Metal Show, Cleveland, Ohio (AGA exhibit).
17-19 Wisconsin Utilities Association, electric and gas section convention, Schroeder Hotel, Milwaukee.
22-24 American Standards Association, Hotel Roosevelt, New York City.
22-26 National Safety Council, Chicago.
31 NEGA operating division, Hotel Statler, Boston.

NOVEMBER 1956

1-2 American Home Laundry Manufacturers Association, Conrad Hilton Hotel, Chicago.
12-15 American Petroleum Institute, Conrad Hilton Hotel, Chicago.
12-16 National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, New Jersey.
12-16 National Hotel Exposition, New York Coliseum, New York City.
25-30 The American Society of Mechanical Engineers, Statler Hotel, New York City.
26-28 SGA advisory council and management conference, Point Clear, Alabama.

JANUARY 1957

4- 5 American Home Laundry Manufacturers Association, annual convention, Chicago.
23 NEGA operating division, Hotel Statler, Boston, Massachusetts.
28-29 Industrial Heating Equipment Association, Washington, D. C.

FEBRUARY 1957

4- 8 Western winter radio-television and appliance market, Western Merchandise Mart, San Francisco.
25-Mar. 1 American Society of Heating and Air Conditioning Engineers, Chicago.

MARCH 1957

11-15 National Association of Corrosion Engineers, Kiel Auditorium, St. Louis, Missouri.
18-20 Mid-West Gas Association, Hotel Nicollet, Minneapolis, Minnesota.
21-22 NEGA annual meeting, Hotel Statler, Boston.
28-29 Oklahoma Utilities Association, annual convention, Tulsa, Oklahoma.

APRIL 1957

8-10 National conference of electric and gas utility accountants, Sheraton-Park Hotel, Washington, D. C.

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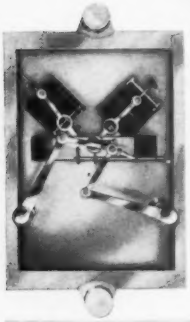

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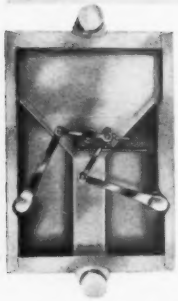

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